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Pseudosquilla lessinea n. sp. (Crustacea, Stomatopoda, Pseudosquillidae) and *Scyllarides bolcensis* n. sp. (Crustacea, Decapoda, Scyllaridae) from the lower Eocene (Ypresian) of Monte Postale (Altissimo, Vicenza, NE Italy)

Abstract – Stomatopods and scyllarids have previously been reported from the “Pesciara” of Bolca (Verona) by Secretan (1975) and Förster (1984). The recent discovery of new stomatopod and scyllarid specimens from Monte Postale (Altissimo – Vicenza) increases the carcinologic knowledge from the Cenozoic of Italy. The order Stomatopoda Latreille, 1817, includes *Pseudosquilla lessinea* n. sp. (Pseudosquillidae Manning, 1977). The infraorder Achelata Scholz & Richter, 1995, includes *Scyllarides bolcensis* n. sp. (Scyllaridae Latreille, 1825). *Pseudosquilla* Dana, 1852, has known to date by only one Recent species and two fossil species from the upper Eocene of Germany and from the lower Oligocene of Italy. This record extends its stratigraphic range into the lower Eocene. *Scyllarides* Gill, 1898, known to date only from the Eocene of Great Britain, is reported for the first time in the fossil record of Italy.

Key words: Crustacea, Stomatopoda, Decapoda, lower Eocene, Italy.

Riassunto – *Pseudosquilla lessinea* n. sp. (Crustacea, Stomatopoda, Pseudosquillidae) e *Scyllarides bolcensis* n. sp. (Crustacea, Decapoda, Scyllaridae) dell’Eocene inferiore (Ypresiano) del Monte Postale (Altissimo, Vicenza, NE Italia).

Stomatopodi e scyllaridi sono stati precedentemente segnalati da Secretan (1975) e Förster (1984) nella “Pesciara” di Bolca (Verona). La recente scoperta di nuovi esemplari di stomatopodi e di scyllaridi, provenienti dal Monte Postale (Altissimo – Vicenza), incrementa le conoscenze carcinologiche del Cenozoico d’Italia. L’ordine Stomatopoda Latreille, 1817 comprende *Pseudosquilla lessinea* n. sp. (Pseudosquillidae Manning, 1977). L’infraordine Achelata Scholz & Richter, 1995 comprende *Scyllarides bolcensis* n. sp. (Scyllaridae Latreille, 1825). *Pseudosquilla* Dana, 1852 è conosciuto finora con una specie recente e due specie fossili dell’Eocene superiore della Germania e dell’Oligocene inferiore dell’Italia. Questa scoperta estende la sua distribuzione stratigrafica all’Eocene inferiore. *Scyllarides* Gill, 1898 conosciuto finora solo nell’Eocene dell’Inghilterra, viene segnalato per la prima volta nel record fossile d’Italia.

Parole chiave: Crustacea, Stomatopoda, Decapoda, Eocene inferiore, Italia.

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Introduction and geological setting

The studied specimens were discovered during two recent field surveys (2004, 2005) carried out in the Eocene ichthyolitic deposits of Monte Postale (Altissimo - Vicenza) by the Museo di Storia Naturale di Verona (Fig. 1). Monte Postale is located close to the “Pesciara” of Bolca, 25 km NE of Verona (N Italy), world famous for the exceptional preservation of the invertebrate and vertebrate fossils. Monte Postale shows an alternation of light limestone with foraminifers and invertebrates (small corals and bivalves), marly layers with trunks perforated by lithodomouses, limestone with land plants, algae, invertebrates, and rare fishes, levels with crustaceans and layers with large fishes (*Eoplatax*, *Sphyraena*, *Narcine*). The levels with fishes of Monte Postale could be more recent than those of “Pesciara” of Bolca or they could be coeval, but representing a different deposition environment. As reported by Papazzoni & Trevisani (2006), the first study of the Bolca area dates back to Fabiani (1912) who proposed the “Spileccian” stage. Later Fabiani (1914, 1915) provided a very detailed description of the geology and palaeontology of the surroundings of Bolca, including the stratigraphical sketch of the Monte Postale section (Fig. 2). According to the study of the calcareous nannoplankton carried out by Medizza (1975), the age of the Bolca area has been referred to the lower-middle Eocene transition. Recently, the new study carried out by Papazzoni & Trevisani (2006) on larger foraminifers allowed assignment of the whole ichthyolitic sequence of the “Pesciara” of the Bolca area to the lower Eocene (upper Ypresian: middle Cuisian).

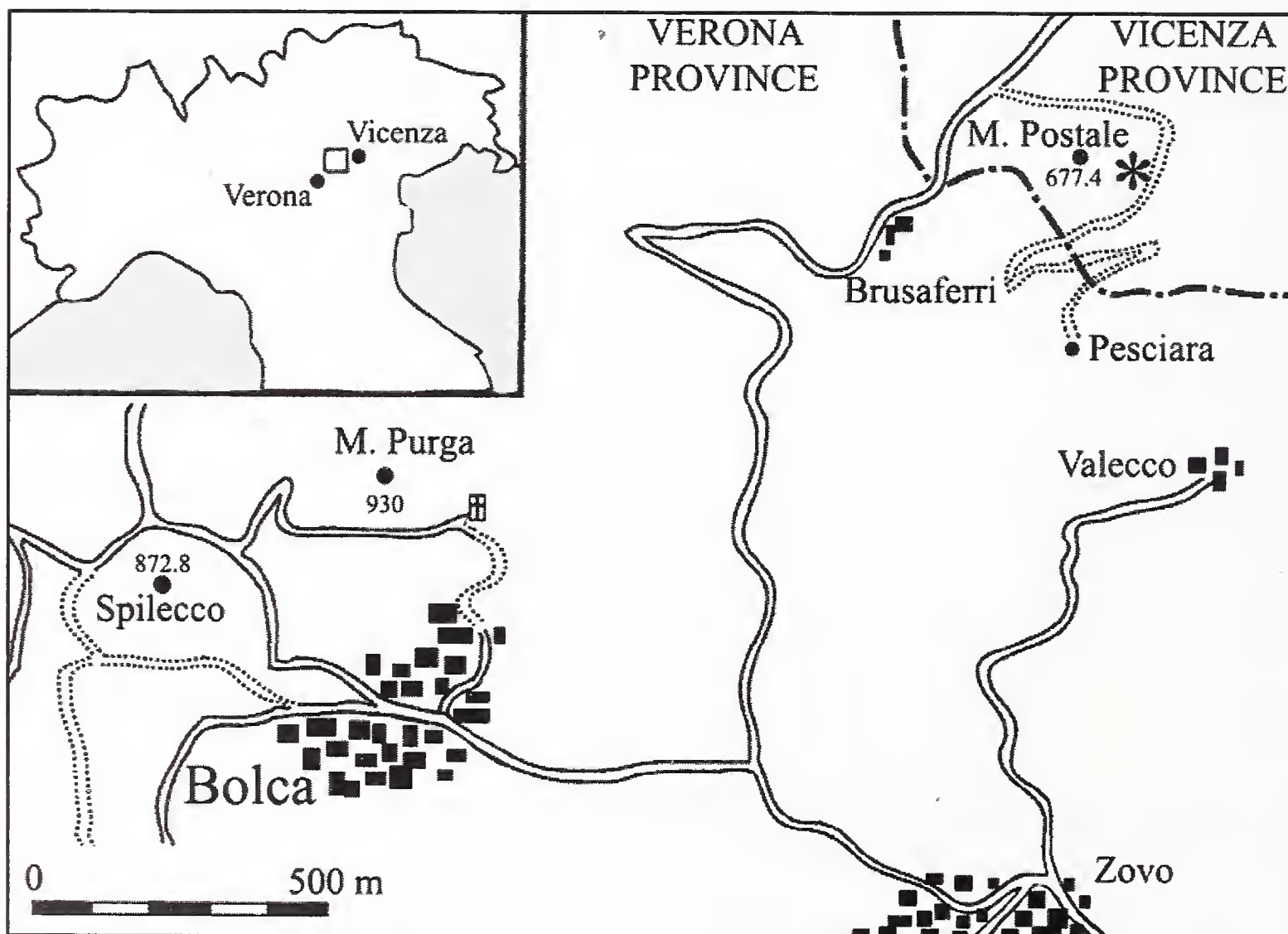


Fig. 1 – Monte Postale area (*). / Area del Monte Postale (*).

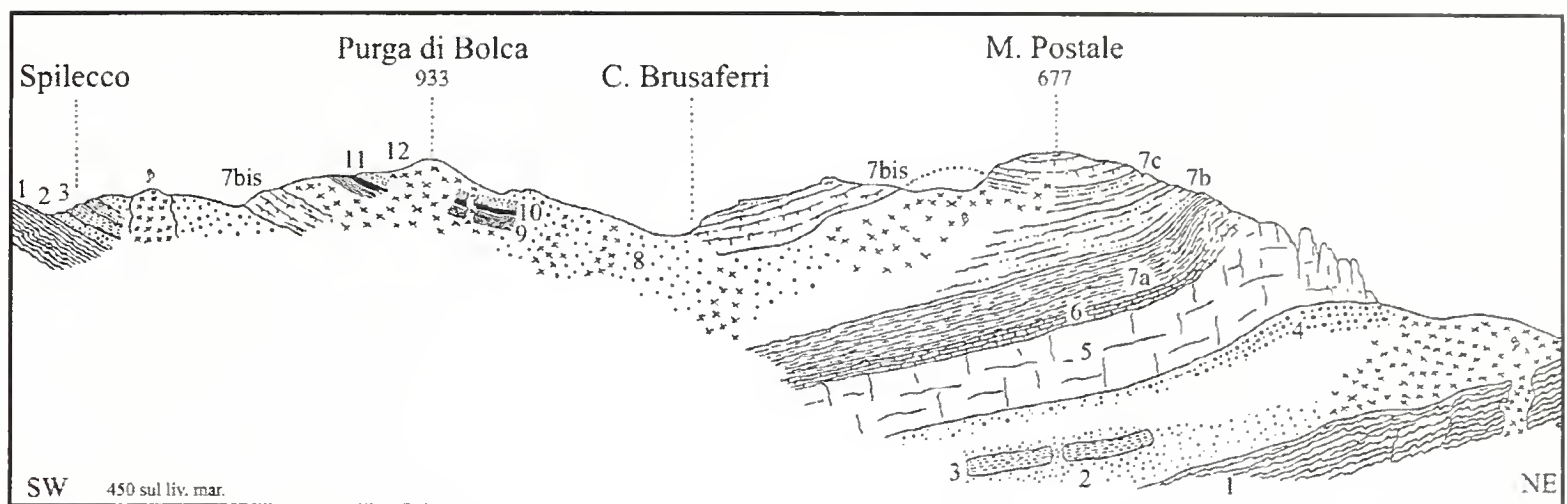


Fig. 2 – Profile of M. Postale - M. Purga of Bolca - Spilecco (from Fabiani, 1915). / Profilo M. Postale - M. Purga di Bolca - Spilecco (da Fabiani, 1915)].

Material

The studied sample includes 2 complete specimens, housed in the Museo di Storia Naturale di Verona (IGVR). The specimens are preserved on the surface layer and their preparation was difficult as a result of the hardness of the surrounding rock. The studied specimens are ascribed to *Pseudosquilla lessinea* n. sp. (Pseudosquillidae Manning, 1977) and *Scyllarides bolcensis* n. sp. (Scyllaridae Latreille, 1825).

Systematic Paleontology

Order Stomatopoda Latreille, 1817
 Superfamily Gonodactyloidea Giesbrecht, 1910
 Family Pseudosquillidae Manning, 1977
 Genus *Pseudosquilla* Dana, 1852

Type species: *Squilla ciliata* Fabricius, 1787.

Included species: *Pseudosquilla ciliata* (Fabricius, 1787) (Recent); *P. berica* De Angeli & Messina, 1996 (fossil); ?*P. wulfi* Förster, 1982 (fossil).

Pseudosquilla lessinea n. sp.

Figs. 3, 4

Diagnosis: medium-sized stomatopod; subtriangular telson with three pairs of carinae in addition to median carina and lateral margins with three pairs of teeth; uropodal protopod ending in two slender, flattened spines.

Etymology: the trivial name alludes to Monti Lessini where the studied specimen was discovered.

Holotype: IGVR 67497-67291 (part and counter-part).

Type locality: Monte Postale (Altissimo - Vicenza).

Geological age: lower Eocene (Ypresian).

Occurrence: one complete specimen in dorsal view, 8.5 cm (maximum length), 2.3 cm (maximum width). IGVR 67497 (part) and 67291 (counter-part).

Description. Medium-sized stomatopod with anterior part poorly preserved. Carapace, rostral plate, and thoracic somites not preserved.

Abdomen. Subcylindric abdominal somites, longer than wide, and with latero-posterior angle developed posteriorly. Maximum width on somite II. Width reduced progressively backwards from somite III to somite VI. Somite VI with one pair of submedian carinae, one pair of intermediate carinae, and one pair of lateral carinae. Telson subtriangular, as long as wide, with lateral margins with three pairs of primary teeth. Lateral teeth weakly developed. Elongate intermediate teeth with curved outer margin. Submedian teeth with one movable spine. Dorsal surface with three carinae on either side of median carina. Exopod with proximal segment elongate and serrate on outer margin. Oval distal segment elongate and flat. Uropodal protopod terminating in two slender, flattened spines, inner spine longer. Oval endopod elongate and flat.



Fig. 3 – *Pseudosquilla lessinea* n. sp., holotype (olotipo), IGVR 67497 (x 1.5).

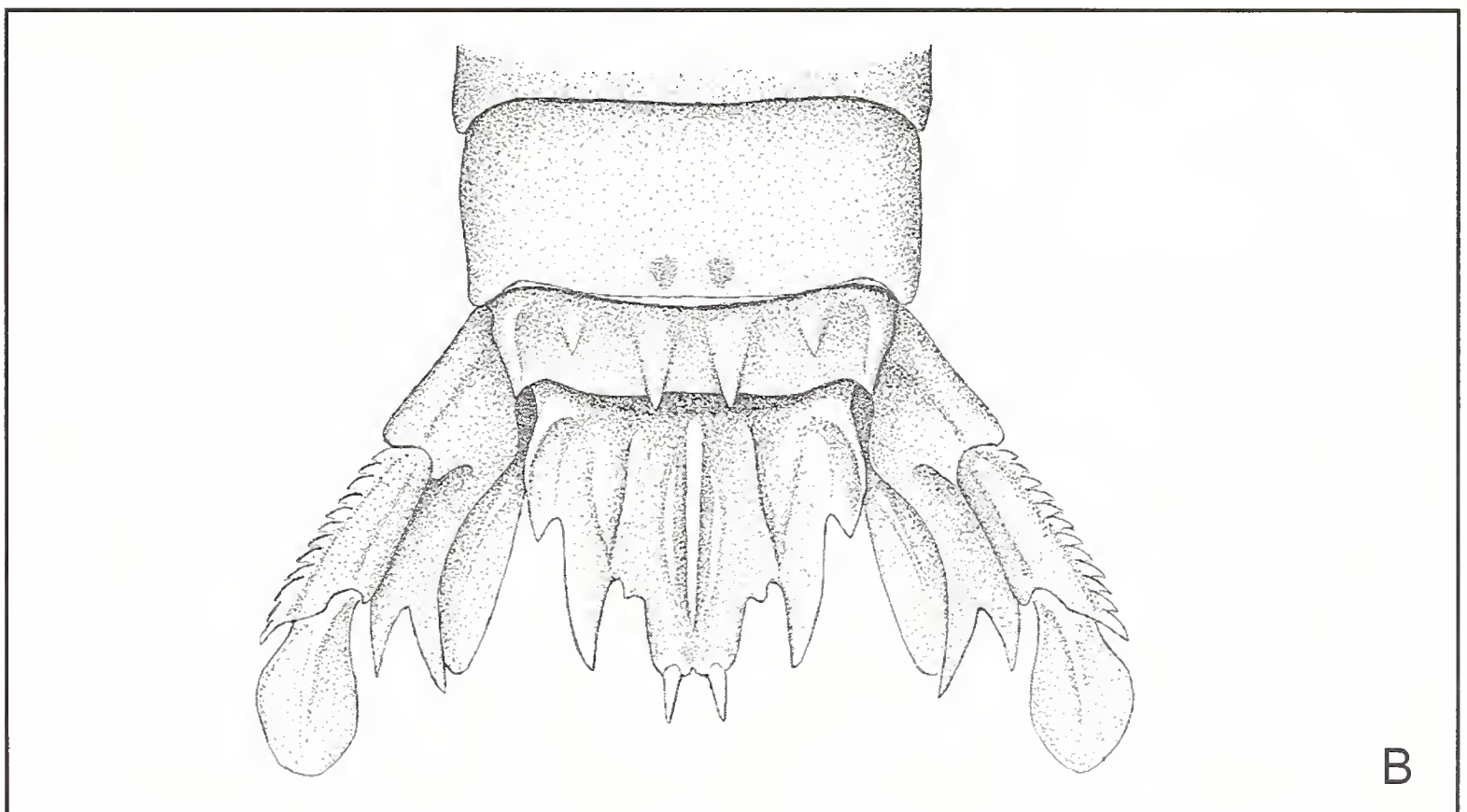


Fig. 4 – A) *Pseudosquilla lessinea* n. sp., IGVR 67497, detail of the tail fan (dettaglio del ventaglio caudale) (x 2). B) *Pseudosquilla lessinea* n. sp., IGVR 67497, reconstruction of the tail fan (ricostruzione del ventaglio caudale).

Discussion. The outcrops of the “Pesciara” of Bolca and Monte Postale are known for the report of many specimens of *Lysiosquilla antiqua* (Münster, 1842). Secretan (1975) reviewed this species based upon many specimens housed in the Museo di Storia Naturale di Verona and Museo di Geologia e Paleontologia dell’Università di Padova, erecting for some specimens the subspecies *L. antiqua* var. *minor* Secretan, 1975. Recently De Angeli & Beschin (2006) described a specimen

of *L. antiqua* from Monte Bolca, housed in Museo Civico “G. Zannato” of Montebelluna Maggiore (Vicenza). Schram & Müller (2004) considered *L. antiqua* var. *minor* Secretan, 1975, to be a synonym of *L. antiqua*. *Pseudosquilla lessinea* n. sp. differs from *L. antiqua* in having a wide and flat subtriangular telson and three pairs of spines on the posterior margin.

Pseudosquilla lessinea n. sp. has some morphological affinities with *P. ciliata* (widespread in tropical seas except the Eastern Pacific). The extant species differs from the new species in having shorter intermediate spines and more developed median spines on the posterior margin of telson.

Two fossil species belong to *Pseudosquilla*: *P. berica* De Angeli & Messina, 1996, from the lower Oligocene (Rupelian) of Perarolo (Vicenza); ?*P. wulfi* Förster, 1982, from the upper Eocene of Tagebau Helmstedt (Germany). *Pseudosquilla berica* differs from the new species by having the telson with a more raised median carina and longer median spines and short intermediate spines on the posterior margin. ?*Pseudosquilla wulfi* differs from the new species by possessing a wider telson having four pairs of carinae.

The systematics of Stomatopoda was discussed by Manning (1995), Ahyong (2001) and Ahyong & Harling (2000). The catalogue of the Recent and fossil species by Schram & Müller (2004) has included the Palaeozoic forms of the suborder Archaeostomatopodea Schram, 1969, and the Mesozoic and Cenozoic forms of the suborder Unipeltata Latreille, 1825. The complete check list of the fossil species was updated by De Angeli & Beschin (2006).

The species from the Palaeozoic, recently reviewed by Schram (2007) are the following: *T. theridion* Schram, 1969 (middle Pennsylvanian - United States); *T. gignation* Schram, 2007 (middle Pennsylvanian - United States) (Tyrannophontidae Schram, 1969); *G. fraiponti* (Van Straelen, 1923) (Carboniferous - Belgium); *Gorgonophontes peleron* Schram, 1984 (upper Pennsylvanian - United States) (Gorgonophontidae Schram, 2007); *D. acanthocercus* (Jenner, Hof & Schram, 1998) (middle Mississippian - United States); *D. pattoni* (Peach, 1908) (Carboniferous - Scotland); *D. schoellmanni* Schram, 2007 (Carboniferous - Germany) (Daidalidae Schram, 2007).

The Mesozoic species are the following: *Archaeosculda phoenicia* Ahyong, Garassino & Gironi, 2006, and *Pseudosculda laevis* (Schlüter, 1872) (Upper Cretaceous - Lebanon) (Pseudosculdidae Dames, 1886); *Sculda pennata* Münster, 1840, *S. pusilla* Kunth, 1870, and *S. spinosa* Kunth, 1870 (Jurassic - Germany); *S. syriaca* Dames, 1886 (Upper Cretaceous - Lebanon) (Sculdidae Dames, 1886); *Lysiosquilla nkporoensis* Förster, 1982 (Upper Cretaceous - Nigeria) (Lysiosquillidae Giesbrecht, 1910); *Squilla cretacea* Schlüter, 1868 (Upper Cretaceous - Germany); *Ursquilla yehoachi* (Remy & Avnimelech, 1955) (Upper Cretaceous - Israel and Jordan) (Squillidae Latreille, 1802); *Paleosquilla brevicoxa* Schram, 1968 (Upper Cretaceous - Columbia) (uncertain family).

The Cenozoic species are the following: *Bathysquilla wetherelli* (Woodward, 1879) (Eocene - Great Britain) (Bathysquillidae Manning, 1967); *Hemisquilla adalaidensis* Rathbun, 1926 (middle Eocene - United States) (Hemisquillidae Manning, 1980); *Pseudosquilla lessinea* n. sp. (lower Eocene - Italy); ?*P. wulfi* Förster, 1982 (upper Eocene - Germany); *P. berica* De Angeli & Messina, 1996 (lower Oligocene - Italy) (Pseudosquillidae Manning, 1977); *Lysiosquilla antiqua* (Münster, 1842) (lower-middle Eocene - Italy); *L. messinai* De Angeli, 1997 (lower Oligocene - Italy); *Lysiosquilla* sp. (middle Eocene - Italy); *Topangosquilla gravansi* Hof & Schram, 1998 (middle Miocene - United States) (Lysiosquillidae

Giesbrecht, 1910); *Coronidopsis albanellensis* De Angeli & Beschin, 2006 (middle Eocene - Italy) (Eurysquillidae Manning, 1977); *Angelosquilla altamirensis* Hof & Schram, 1998 (middle Miocene - United States); *Leesquilla bajee* Yun, 1985, *L. sunii* Yun, 1985, *Pohsquilla neonica* Yun, 1985, and *P. scissodentica* Yun, 1985 (lower-middle Miocene - Korea); *Shako tomidai* Karasawa, 1996 (lower Miocene - Japan); *Squilla breoniensis* De Angeli & Beschin, 2006 (Eocene - Italy); *S. hollandi* Förster, 1982 (upper Eocene - Germany); *S. laingae* Hof & Schram, 1998 (middle Miocene - United States); *S. miocenica* Lovisato, 1894 (Miocene - Italy and Spain); *S. sonomana* (Rathbun, 1926) (Pliocene - United States); *Clorida angolia* (Berry, 1939) (Eocene - Angola) (Squillidae Latreille, 1802).

The fossil stomatopods known to date in Italy were reported by Lovisato (1894), Münster (1842), Secretan (1975), De Angeli & Messina (1996), De Angeli (1997), De Angeli & Beschin (2006). Four species are known to date from the Eocene: *Pseudosquilla lessinea* n. sp. and *Lysiosquilla antiqua* (Münster, 1842) [lower Eocene - “Pesciara” of Bolca (Verona) and Monte Postale (Vicenza)]; *Coronidopsis albanellensis* De Angeli & Beschin, 2006 [middle Eocene - “Albanello” quarry, Nogarole Vicentino (Vicenza)]; *Squilla breoniensis* De Angeli & Beschin, 2006 [middle Eocene - Breonio (Verona)]. Two species are reported from the Oligocene, *Pseudosquilla berica* De Angeli & Messina, 1996, and *Lysiosquilla messinai* De Angeli, 1997 [lower Oligocene - Perarolo (Vicenza)], and one from the Miocene of Sardinia, *Squilla miocenica* Lovisato, 1894.

Order Decapoda Latreille, 1802
 Infraorder Achelata Scholz & Richter, 1995
 Superfamily Palinuroidea Latreille, 1802
 Family Scyllaridae Latreille, 1825
 Genus *Scyllarides* Gill, 1898

Type species: *Scyllarus aequinoctialis* Lund, 1793, by original designation.

Included species: *S. aequinoctialis* (Lund, 1793) (Recent); *S. astori* Holthuis, 1960 (Recent); *S. brasiliensis* Rathbun, 1906 (Recent); *S. deceptor* Holthuis, 1963 (Recent); *S. delfosi* Holthuis, 1960 (Recent); *S. elisabethae* (Ortmann, 1894) (Recent); *S. haanii* (De Haan, 1841) (Recent); *S. herklotsii* (Herklots, 1851) (Recent); *S. latus* (Latreille, 1802) (Recent); *S. nodifer* (Stimpson, 1866) (Recent); *S. obtusus* Holthuis, 1993 (Recent); *S. roggveeni* Holthuis, 1967 (Recent); *S. squammosus* (H. Milne Edwards, 1837) (Recent); *S. tridacnophaga* Holthuis, 1967 (Recent); *S. koenigi* (Bell, 1858) (fossil); *S. punctatus* Woods, 1925 (fossil); *S. tuberculatus* (König, 1825) (fossil).

Scyllarides bolcensis n. sp.
 Figs. 5, 6, 7

Diagnosis: carapace highly vaulted, without lateral cervical incision; carapace without postorbital spine; carapace with a strongly marked median ridge; grooves of carapace rather indistinct; inner orbital margin smooth; median ridges on abdominal somites hardly noticeable.

Etymology: the trivial name alludes to Bolca, one of the most famous Eocene locality of the world.

Holotype: IGVR 69353.

Type locality: Monte Postale (Altissimo - Vicenza).

Geological age: lower Eocene (Ypresian).

Occurrence: one complete specimen in dorsal view, 8.5 cm (length without tail fan), 5 cm (maximum width). IGVR 69353.

Description. Medium-sized scyllarid with exoskeleton strongly tuberculate with pits.

Carapace. Subsquare carapace highly vaulted, slightly wider than long, without lateral cervical incision. Orbits near the anterolateral angles. Orbits not deeply incised with inner smooth orbital margin. Postorbital spine absent. Median ridge strongly marked. Grooves rather indistinct. Lateral margins of carapace smooth. Dorsal surface of carapace strongly tuberculate with apical pits.



Fig. 5 – *Scyllarides bolcensis* n. sp., holotype (olotipo), IGVR 69353 (x 1.5).

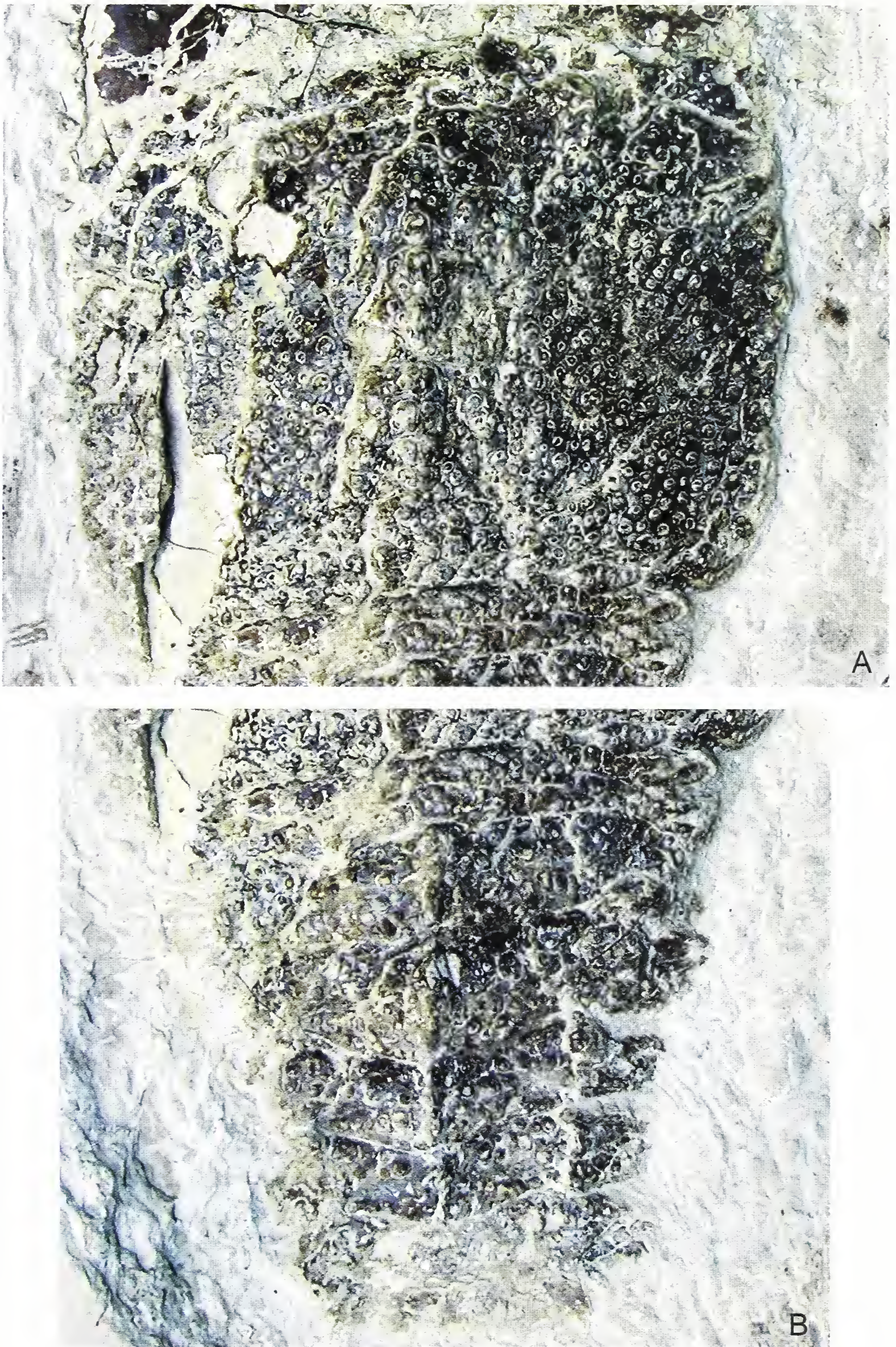


Fig. 6—A) *Scyllarides bolcensis* n. sp., IGVR 69353, detail of the carapace (dettaglio del carapace) (x 2).
B) *Scyllarides bolcensis* n. sp., IGVR 69353, detail of the abdomen (dettaglio dell'addome) (x 2).

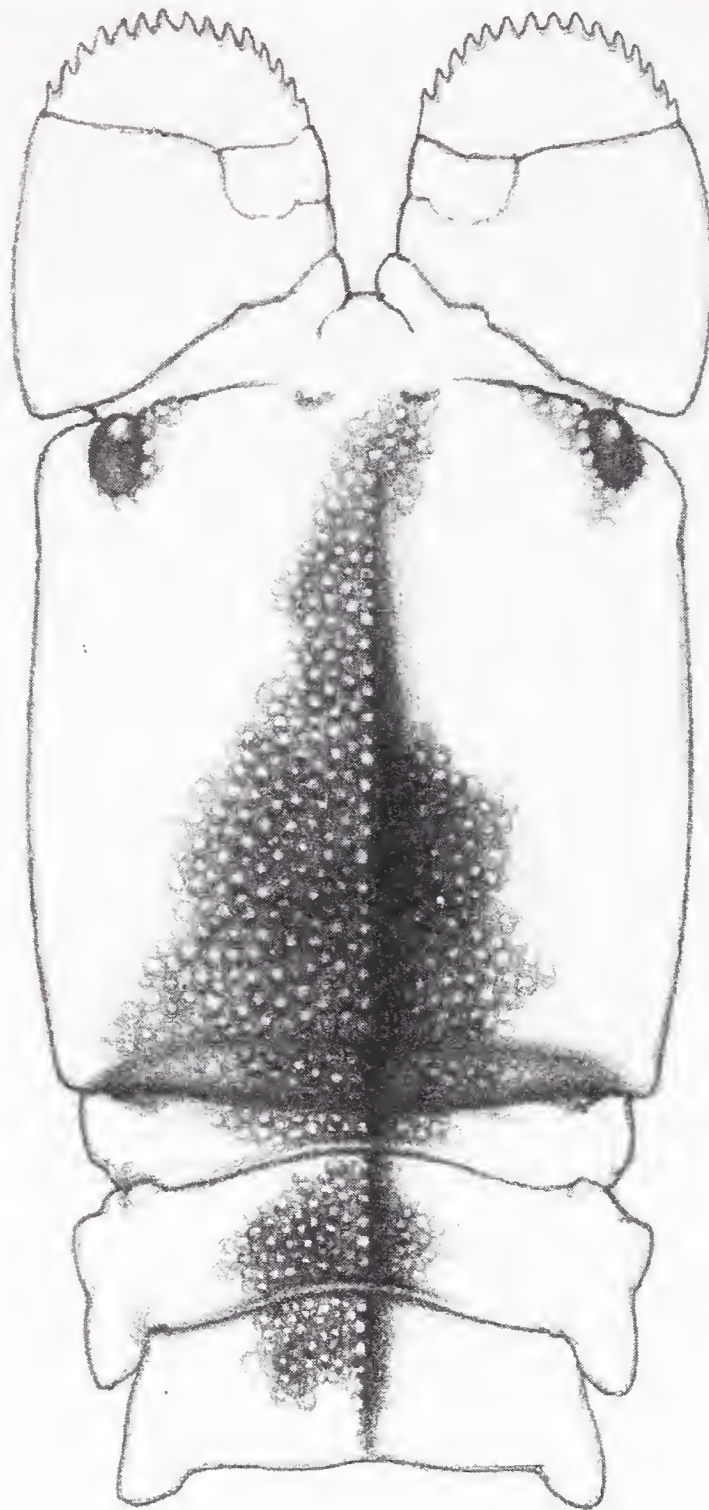


Fig. 7 – *Scyllarides bolcensis* n. sp., incomplete reconstruction (parziale ricostruzione).

Abdomen. Abdominal somites in bearing median ridges without dorsal sculpture. Pleurae of somites downwards, terminations directed anteriorly. Dorsal surface of somites strongly tuberculate with apical pits.

Cephalic appendages. Poorly preserved. Distal and lateral margins of antennae finely serrate.

Thoracic appendages. Not preserved.

Abdominal appendages. Not preserved.

Discussion. Holthuis (1991) and Poore (2004) summarized the main morphological characters of this genus: carapace highly vaulted, with shallow or no lateral cervical incision; carapace without postorbital spine; abdominal somite I without dorsal transverse groove; abdominal somites with only median ridge, without dorsal sculpture.

These morphological characters are visible on the studied specimen that has been ascribed to this genus. At present, *Scyllarides* is known in the fossil record based upon three species, *S. punctatus* Woods, 1925 [Lower Cretaceous (Albian) -

Great Britain], *S. koenigi* (Bell, 1858) and *S. tuberculatus* (König, 1825) [lower Eocene (Ypresian) - Great Britain] (Woods, 1925). *Scyllarides punctatus* differs from the new species in having a longer and wider carapace, gastric region with a prominent median and two posterior spines, well marked cervical and branchiocardiac grooves, cardiac region with two tubercles, and lateral ridges extending from near the inner margin of the orbits. *Scyllarides koenigi* differs from the new species by having a gastric region with a median ridge having a prominent spiny tubercle, well marked cervical and branchiocardiac grooves, and carinate lateral margins of carapace bearing two large spines behind a notch of the cervical groove. *Scyllarides tuberculatus* differs from the new species by having a large spiny tubercle on the median carina and another between this and the cardiac carina, well marked cervical and branchiocardiac grooves.

Scyllaridae is previously known in the “Pesciara” of Bolca” in the form of *Parribacus cristatus*, reported by Förster (1984).

Conclusion

Many stomatopods and decapods described by Münster (1842), Secretan (1975), Förster (1984), and Garassino & Novati (2001) occurred in the Eocene layers of “Pesciara” of Bolca and Monte Postale. The species known to date are the following.

Stomatopoda: *Lysiosquilla antiqua* (Münster, 1842) (Squillidae); *Pseudosquilla lessinea* n. sp. (Pseudosquillidae).

Decapoda: *Penaeus bolcensis* Secretan, 1975; *Penaeus obtusus* Secretan, 1975; *Pseudobombur nummuliticus* Secretan, 1975 (Penaeidae); *Protaxius eocenicus* Secretan, 1975; *Protaxius* sp. (Axiidae); *Justitia desmaresti* (Massalongo, 1854) (Palinuridae); *Scyllarides bolcensis* n. sp.; *Parribacus cristatus* Förster, 1984 (Scyllaridae); *Enoplonotus armatus* A. Milne Edwards, 1860; *Macropipus ovalipes* Secretan, 1975; *Portunus* sp. (Portunidae); *Panopeus bolcensis* De Zigno, 1915 (Panopeidae); *Eriphia* sp. (Menippidae); *Archaeocypoda veronensis* Secretan, 1975 (Ocypodidae).

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